

# Low Power Universal Direct Conversion Transmit and Receive (UTR) RF Module for Software Defined Radios, Phase II

Completed Technology Project (2009 - 2012)



## Project Introduction

Conventional software defined radio (SDR) backend signal processors are limited by a priori system definition and RF hardware. Ideally, advanced SDR RF front-end sections would be as flexible as their software back-ends, allowing in-use or in-orbit reconfiguration of original bands and modulation types. The FPMA/UTR proposed herein should meet this challenge. This proposed Innovation is a distillation of Phase I concept evaluations with the goal of yielding a producible and functional prototype with Phase II funding. The proposed RF front-end provides a post-launch, in-orbit reconfigurable RF module and is capable of Hz to >150GHz bandwidth. Benefits include vastly reduced shelf inventory of equipment addressing different RF requirements and permits ever-ready deployment capabilities using a single piece of equipment featuring this proposed RF front-end. The UTR/FPMA's modular open architecture fully complements the flexibility of SDR technology. The UTR/FPMA services communications or radar functionality, narrow (kbps) to ultra-wideband (GHz) modulation bandwidths, center frequencies scalable >150 GHz: herein UHF to Ka band. Small size and exceptional robustness (radiation hardness, reliability) are expected due to low active component count and mainstream manufacturing techniques. The UTR/FPMA RF module uses only conventional technologies but can yield excellent SW&P characteristics.

## Anticipated Benefits

Potential NASA Commercial Applications: 1. In flight reconfigurable SDR agnostic RF front end for current and future RF communications and radar EFA, SDST, STDN, SGLS, TDRSS, Lunar Crew Communications, CEV, networked, surface/harsh environment, etc. 2. DOD software defined radio (JTRS, AMF, etc), terrestrial, airborne, naval, Electronic Warfare, C4ISR 3. Wideband operation and low power are ideal for cognitive and mobile adaptive ad hoc networked (MANET) communications (802.XX) AS WELL AS TRIDITIONAL COMMERCIAL WIRELESS (GSM/EDGE, CDMA, UMTS-WCDMA, etc) 4. Homeland Security and Emergency inter-network access with a single mobile radio 5. This technology is also feasible for radar, and in particular, in collision avoidance automotive applications. Here the six port is configured as a reflectometer that establishes amplitude and phase relations between RF signals. Using a patch antenna at Ka-band frequencies, the sensor module volume would not exceed 3 cubic inches. Maximum range would be about 20 feet with 2% accuracy.



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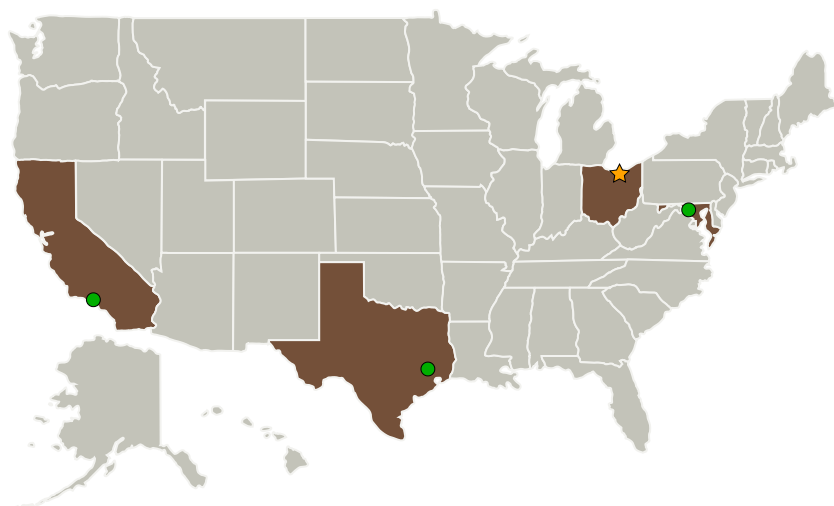
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
Space Micro, Inc.	Supporting Organization	Industry	San Diego, California

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Glenn Research Center (GRC)

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

Carlos Torrez

### Project Manager:

Gary C Jahns

### Principal Investigator:

David Czajkowski

## Primary U.S. Work Locations

California	Maryland
Ohio	Texas

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## Project Transitions

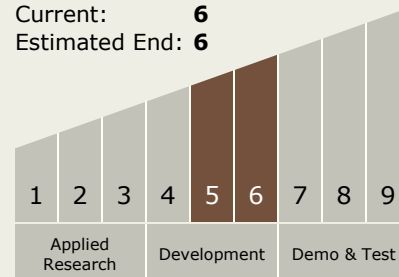
 **September 2009:** Project Start

 **February 2012:** Closed out

**Closeout Summary:** Low Power Universal Direct Conversion Transmit and Receive (UTR) RF Module for Software Defined Radios, Phase II Project Image

## Technology Maturity (TRL)

Start: **5**  
Current: **6**  
Estimated End: **6**



## Technology Areas

### Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - └ TX05.2 Radio Frequency
    - └ TX05.2.6 Innovative Antennas